

Figure A10(c). Plot of VHF Paging Distance from formula;  
 x => Carey Interf. Values without height correction;  
 + => Carey Interf. Values with 3 dB/Octave height correction.

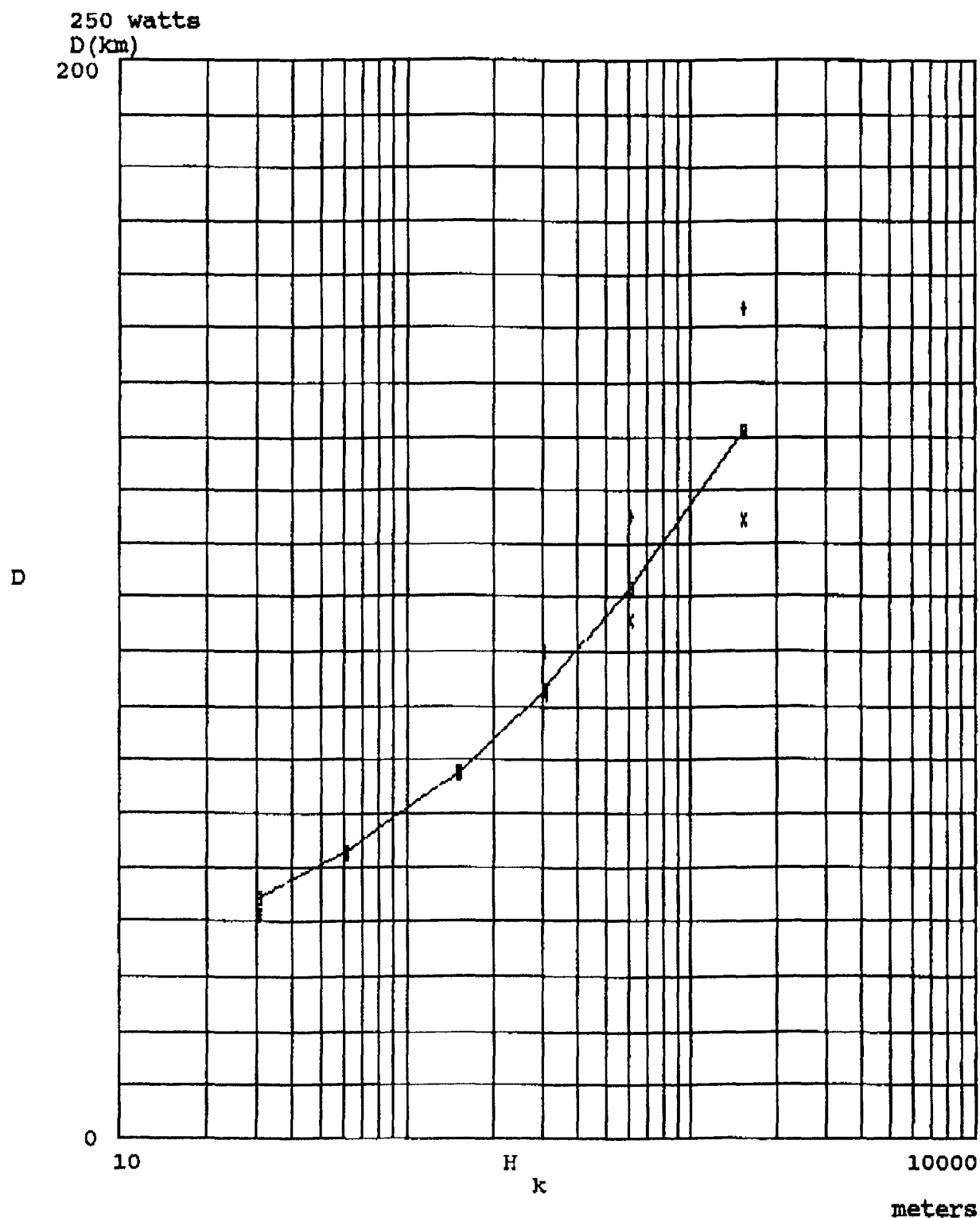


Figure A10(d). Plot of VHF Paging Distance from formula;  
 x => Carey Interf. Values without height correction;  
 + => Carey Interf. Values with 3 dB/Octave height correction.

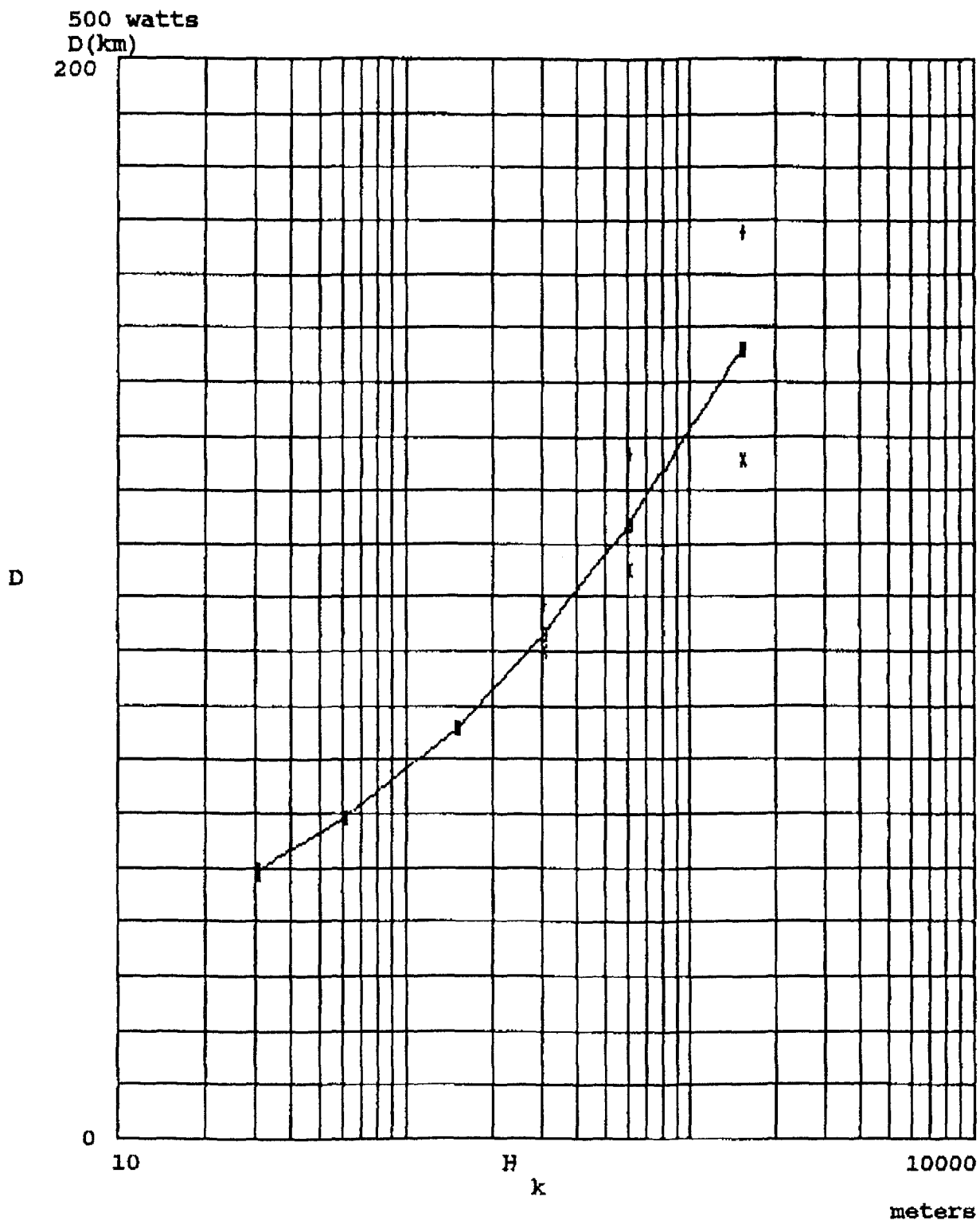


Figure A10(e). Plot of VHF Paging Distance from formula;  
 x => Carey Interf. Values without height correction;  
 + => Carey Interf. Values with 3 dB/Octave height correction.

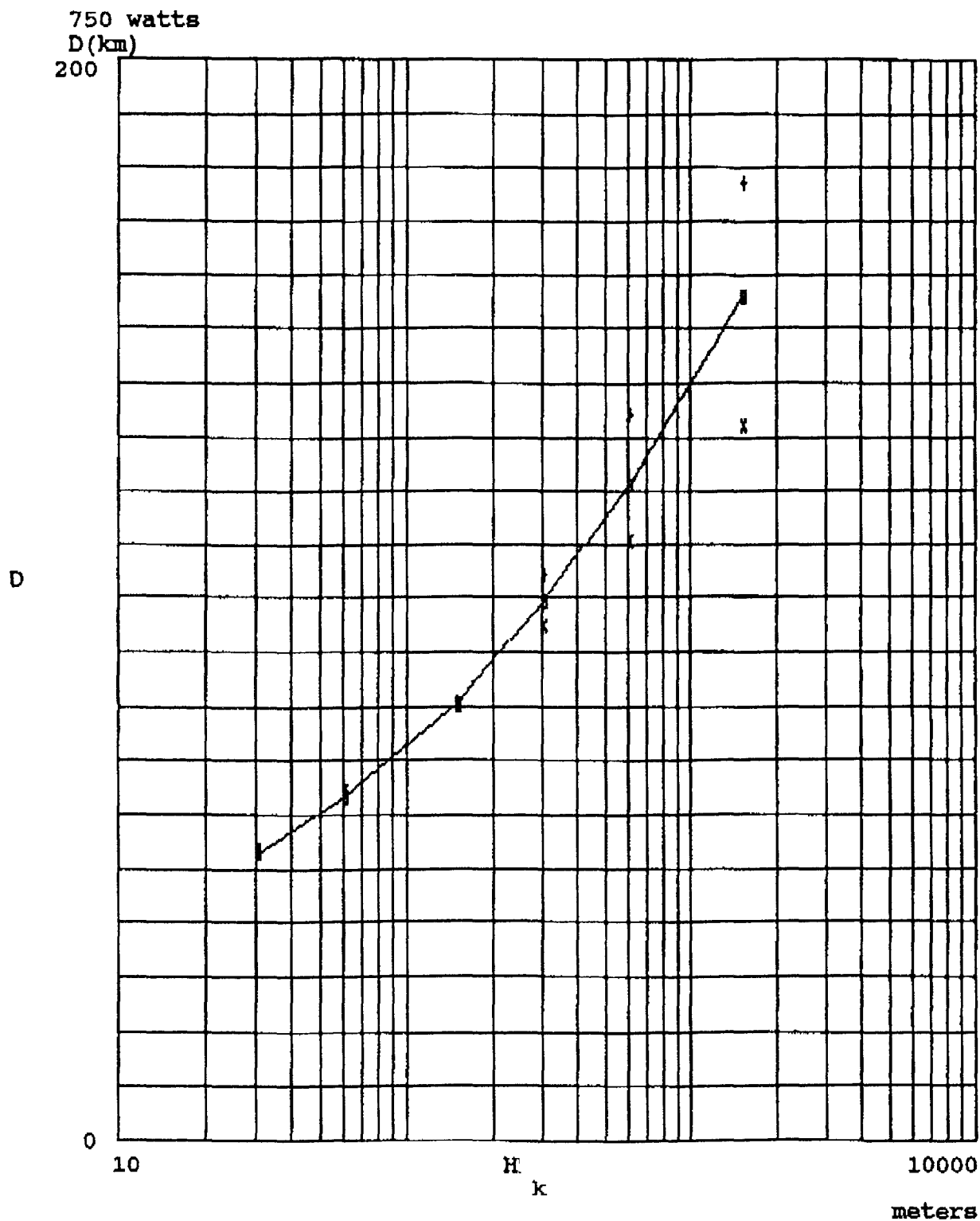


Figure A10(f). Plot of VHF Paging Distance from formula;  
 x => Carey Interf. Values without height correction;  
 + => Carey Interf. Values with 3 dB/Octave height correction.

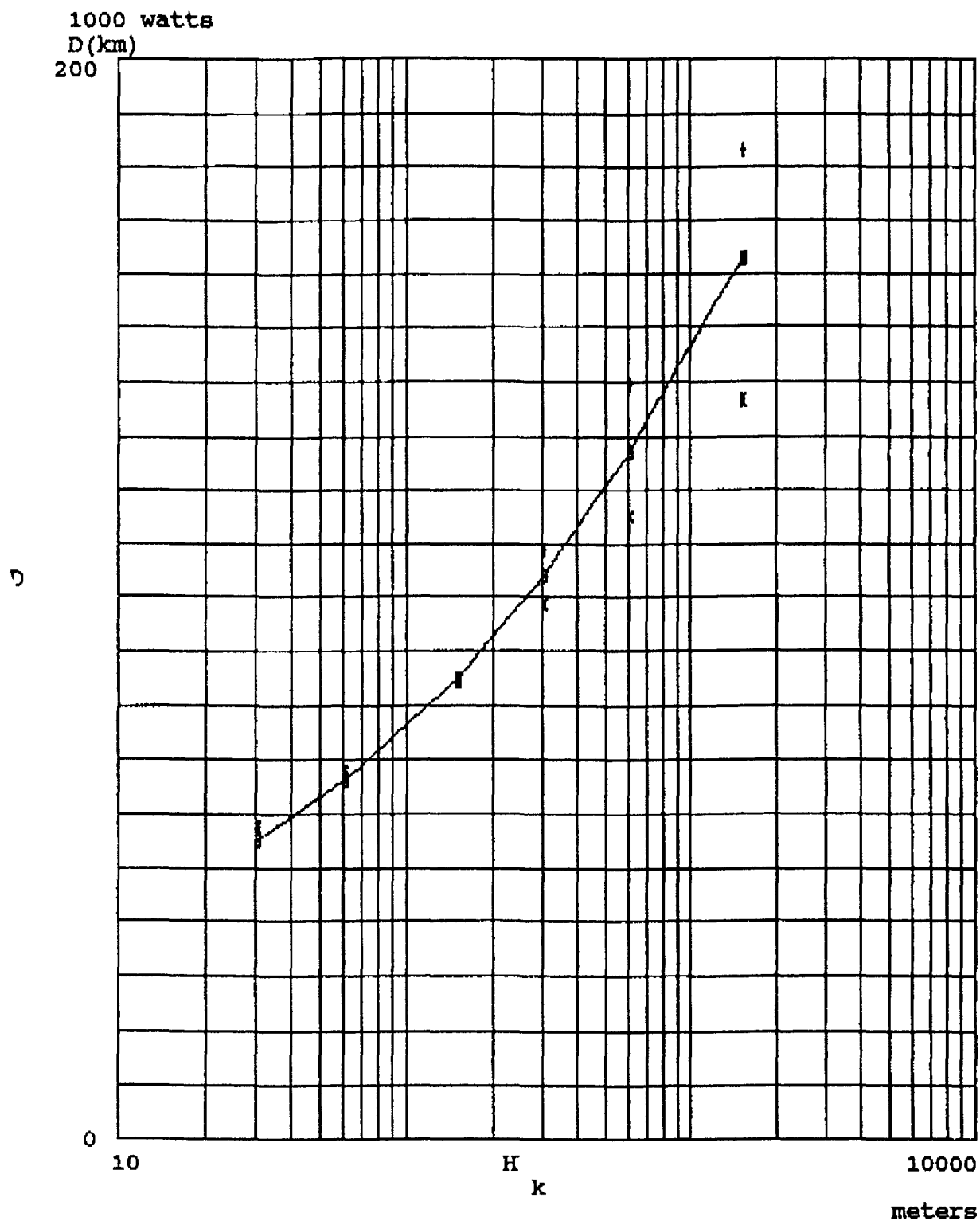


Figure A10(g). Plot of VHF Paging Distance from formula;  
 x => Carey Interf. Values without height correction;  
 + => Carey Interf. Values with 3 dB/Octave height correction.

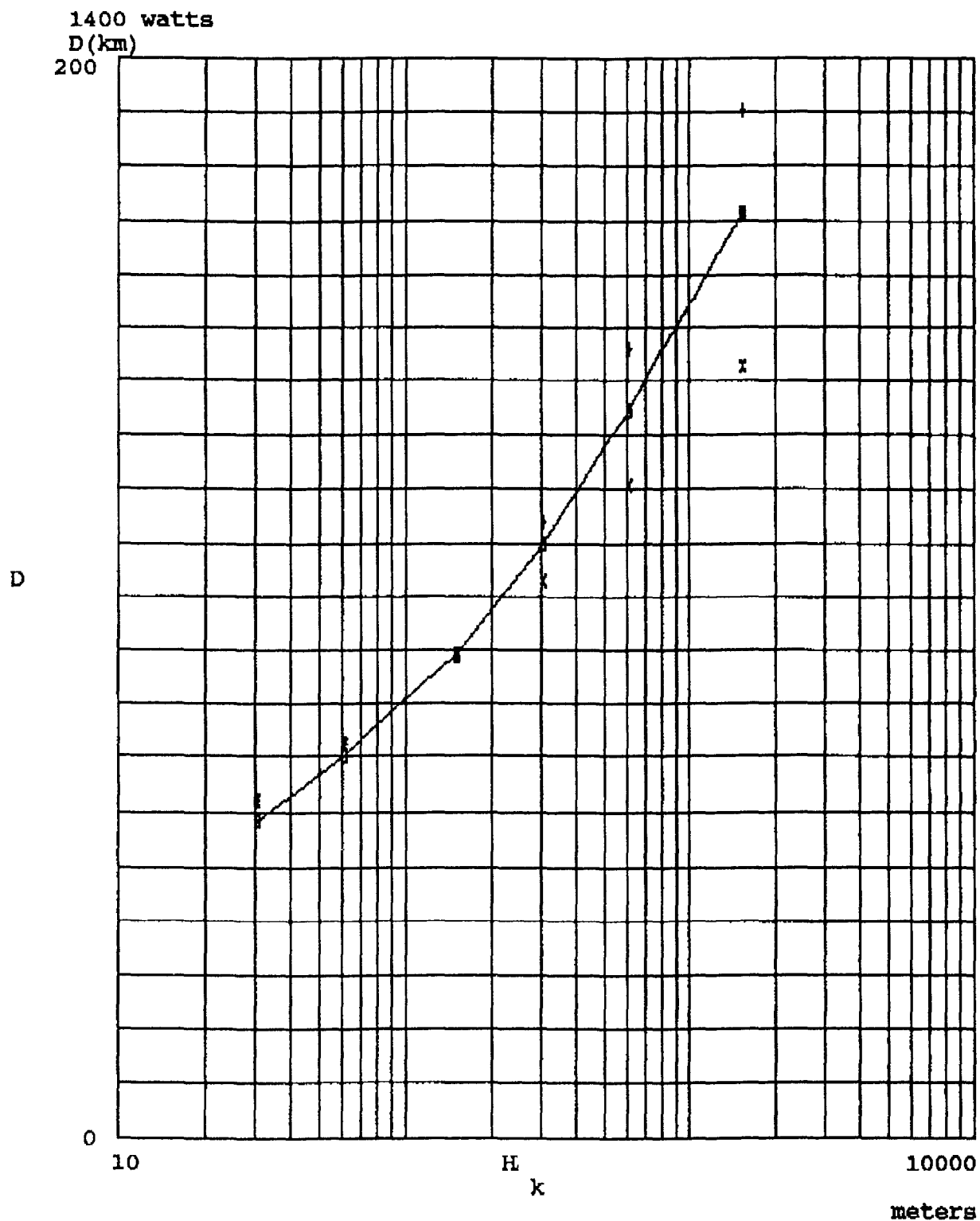


Figure A11. Basic VHF Paging Interference Contour Data.

Elevations Used: 100, 200, 500, 1000, 2000, 5000 ft.  
 30.5, 61.0, 152.4, 304.8, 609.6, 1524 meters

ERP's Used: 50, 100, 250, 500, 750, 1000, 1400 watts

Matrix of Carey Interference Contour Distances (km)  
 up to 500' elevation:

Elevation→				
VL =	28.968	38.785	51.982	E R P ↓
	33.635	44.096	58.419	
	41.36	52.465	67.914	
	48.763	59.385	75.639	
	53.591	64.374	80.467	
	57.615	68.075	84.33	
	62.282	72.26	88.997	

Matrix of Carey Interference Contour Distances (km)  
 without 3 dB/Octave correction above 500' elevation:

IL =	65.018	78.375	92.216
	72.26	85.778	100.906
	82.238	95.595	114.425
	90.123	105.09	125.69
	94.951	110.884	132.127
	98.653	115.39	136.473
	103.32	120.862	142.588

Matrix of Carey Interference Contour Distances (km)  
 with 3 dB/Octave correction above 500' elevation:

IU =	72.26	93.181	125.69
	79.663	101.872	136.473
	90.123	115.229	153.532
	98.653	126.817	167.855
	104.286	134.22	177.028
	108.792	139.53	183.144
	114.264	146.129	190.064

Error Matrix for points up through 500' elevation:

'Formula calculated distance' - 'Carey Interf Contour Distance' (km):

$$ELL = \begin{bmatrix} 4.907 & 1.953 & -0.043 \\ 4.314 & 1.537 & -0.257 \\ 2.737 & 0.554 & -0.368 \\ 0.638 & 0.004 & 0 \\ -0.797 & -0.909 & 0.348 \\ -2.272 & -1.55 & 0.372 \\ -3.802 & -1.967 & 0.488 \end{bmatrix}$$

Standard Deviation of Above Errors:  $\sigma = 9.227$  km

A row by row plot of these errors is presented in Fig. A9.

Error Matrix for points above 500' elevation:

'Formula calculated distance' - 'Carey Interf w/o Correction' (km):

$$ELU = \begin{bmatrix} -1.083 & 0.097 & 9.661 \\ -0.702 & 1.959 & 12.646 \\ 0.81 & 6.09 & 16.641 \\ 2.826 & 8.601 & 20.396 \\ 4.328 & 10.477 & 23.531 \\ 5.378 & 11.725 & 26.355 \\ 6.558 & 13.33 & 29.046 \end{bmatrix}$$

Error Matrix for points above 500' elevation:

'Formula Calculated distance' - 'Carey Interf w Correction' (km):

$$EUU = \begin{bmatrix} -8.325 & -14.709 & -23.813 \\ -8.105 & -14.134 & -22.92 \\ -7.076 & -13.544 & -22.467 \\ -5.704 & -13.125 & -21.769 \\ -5.006 & -12.858 & -21.37 \\ -4.76 & -12.415 & -20.316 \\ -4.386 & -11.937 & -18.43 \end{bmatrix}$$

Error Matrix for points above 500' elevation:

'Formula Calculated distance' - 50/50 Weighted Average of Carey Interf w & w/o Correction' (km):

$$EAU = \begin{bmatrix} -4.704 & -7.306 & -7.076 \\ -4.403 & -6.088 & -5.137 \\ -3.133 & -3.727 & -2.913 \\ -1.439 & -2.262 & -0.687 \\ -0.339 & -1.19 & 1.08 \\ 0.309 & -0.345 & 3.02 \\ 1.086 & 0.696 & 5.308 \end{bmatrix}$$

Error Matrix for all points from proposed equation re  
50/50 weighted Average of Carey Interf w & w/o Correction (km):

$$EA = \begin{bmatrix} 4.907 & 1.953 & -0.043 & -4.704 & -7.306 & -7.076 \\ 4.314 & 1.537 & -0.257 & -4.403 & -6.088 & -5.137 \\ 2.737 & 0.554 & -0.368 & -3.133 & -3.727 & -2.913 \\ 0.638 & 0.004 & 0 & -1.439 & -2.262 & -0.687 \\ -0.797 & -0.909 & 0.348 & -0.339 & -1.19 & 1.08 \\ -2.272 & -1.55 & 0.372 & 0.309 & -0.345 & 3.02 \\ -3.802 & -1.967 & 0.488 & 1.086 & 0.696 & 5.308 \end{bmatrix}$$

Standard Deviation of Above Errors:  $\sigma_A = 17.033$  km



FCC PROPOSED EQUATION:

Error Matrix for points up through 500' elevation:

'FCC equation distance' - 'Carey Interf Contour Distance' (km):

$$EFCCLL = \begin{bmatrix} 3.982 & 1.223 & -0.272 \\ 3.436 & 0.916 & -0.242 \\ 1.96 & 0.134 & 0.069 \\ -0.026 & -0.208 & 0.846 \\ -1.376 & -0.974 & 1.475 \\ -2.782 & -1.498 & 1.72 \\ -4.221 & -1.763 & 2.119 \end{bmatrix}$$

Standard Deviation of Above Errors:  $\sigma_{FCC} = 8.839$  km

Error Matrix for points above 500' elevation:

'FCC equation distance' - 'Carey Interf w/o Correction' (km):

$$EFCCLU = \begin{bmatrix} -2.232 & -2.141 & 6.316 \\ -1.622 & -0.01 & 9.948 \\ 0.307 & 4.63 & 15.114 \\ 2.744 & 7.669 & 20.049 \\ 4.543 & 9.922 & 24.011 \\ 5.828 & 11.471 & 27.492 \\ 7.312 & 13.467 & 31.029 \end{bmatrix}$$

Error Matrix for points above 500' elevation:

'FCC equation distance' - 'Carey Interf w Correction' (km):

$$EFCCUU = \begin{bmatrix} -9.474 & -16.947 & -27.158 \\ -9.025 & -16.103 & -25.619 \\ -7.579 & -15.004 & -23.993 \\ -5.786 & -14.057 & -22.116 \\ -4.791 & -13.414 & -20.889 \\ -4.311 & -12.67 & -19.179 \\ -3.632 & -11.8 & -16.447 \end{bmatrix}$$

Error Matrix for points above 500' elevation:

'FCC equation distance' - '50/50 Weighted Average of Carey Interf w & w/o Correction' (km):

$$EFCCAU = \begin{bmatrix} -5.853 & -9.544 & -10.421 \\ -5.323 & -8.057 & -7.836 \\ -3.636 & -5.187 & -4.439 \\ -1.521 & -3.194 & -1.034 \\ -0.124 & -1.746 & 1.561 \\ 0.759 & -0.6 & 4.157 \\ 1.84 & 0.833 & 7.291 \end{bmatrix}$$

Error Matrix for all points from FCC equation re  
50/50 weighted Average of Carey Interf w & w/o Correction (km):

$$EFCCA = \begin{bmatrix} 3.982 & 1.223 & -0.272 & -5.853 & -9.544 & -10.421 \\ 3.436 & 0.916 & -0.242 & -5.323 & -8.057 & -7.836 \\ 1.96 & 0.134 & 0.069 & -3.636 & -5.187 & -4.439 \\ -0.026 & -0.208 & 0.846 & -1.521 & -3.194 & -1.034 \\ -1.376 & -0.974 & 1.475 & -0.124 & -1.746 & 1.561 \\ -2.782 & -1.498 & 1.72 & 0.759 & -0.6 & 4.157 \\ -4.221 & -1.763 & 2.119 & 1.84 & 0.833 & 7.291 \end{bmatrix}$$

Standard Deviation of Above Errors:  $\sigma_{FCCA} = 23.301$  km

Figure B1. Proposed 931 MHz Service Contour Formula.

The following formula has been developed for calculating 931 MHz Service Contour Distances:

$$d = 0.280 \times h^{(0.545-0.00000598 \times p)} \times p^{(0.244-0.0000117 \times h)}$$

where

d is the radial distance in kilometers  
h is the radial antenna HAAT in meters  
p is the radial ERP in watts

This formula was developed as a fit to the 'Okumura' Reference data originally used to develop the distances in the current FCC tables for 931 MHz paging. The original data is contained in Telocator's Comments filed in CC Docket No. 88-135, RM-5555.

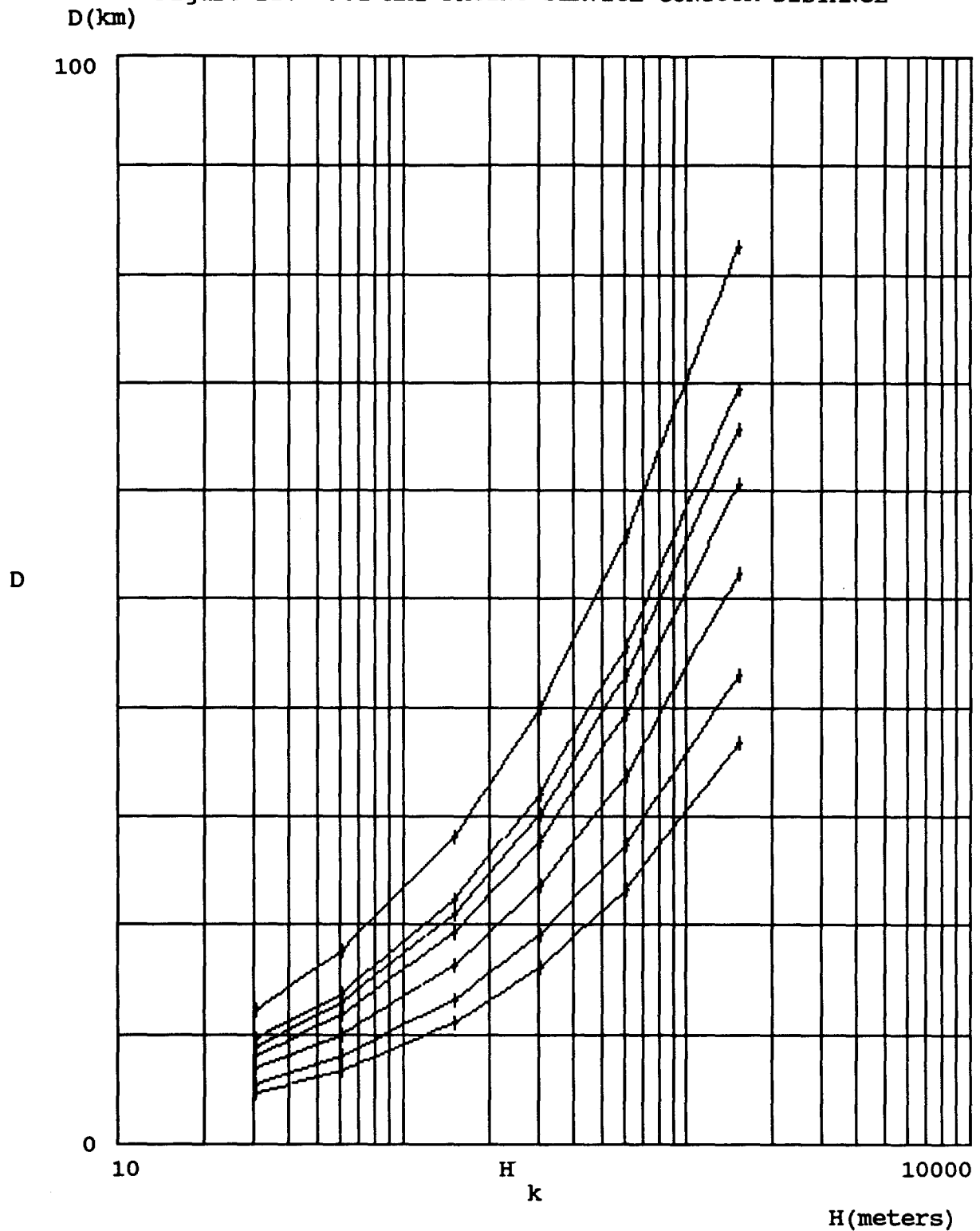
Figure B2 contains a series of plots of the proposed formula.

Figure B3 contains a series of plots of the 'Okumura' Reference data for the same points displayed in Figure B2.

Figure B4 contains a series of plots of the differences between the proposed formula results and the 'Okumura' Reference data.

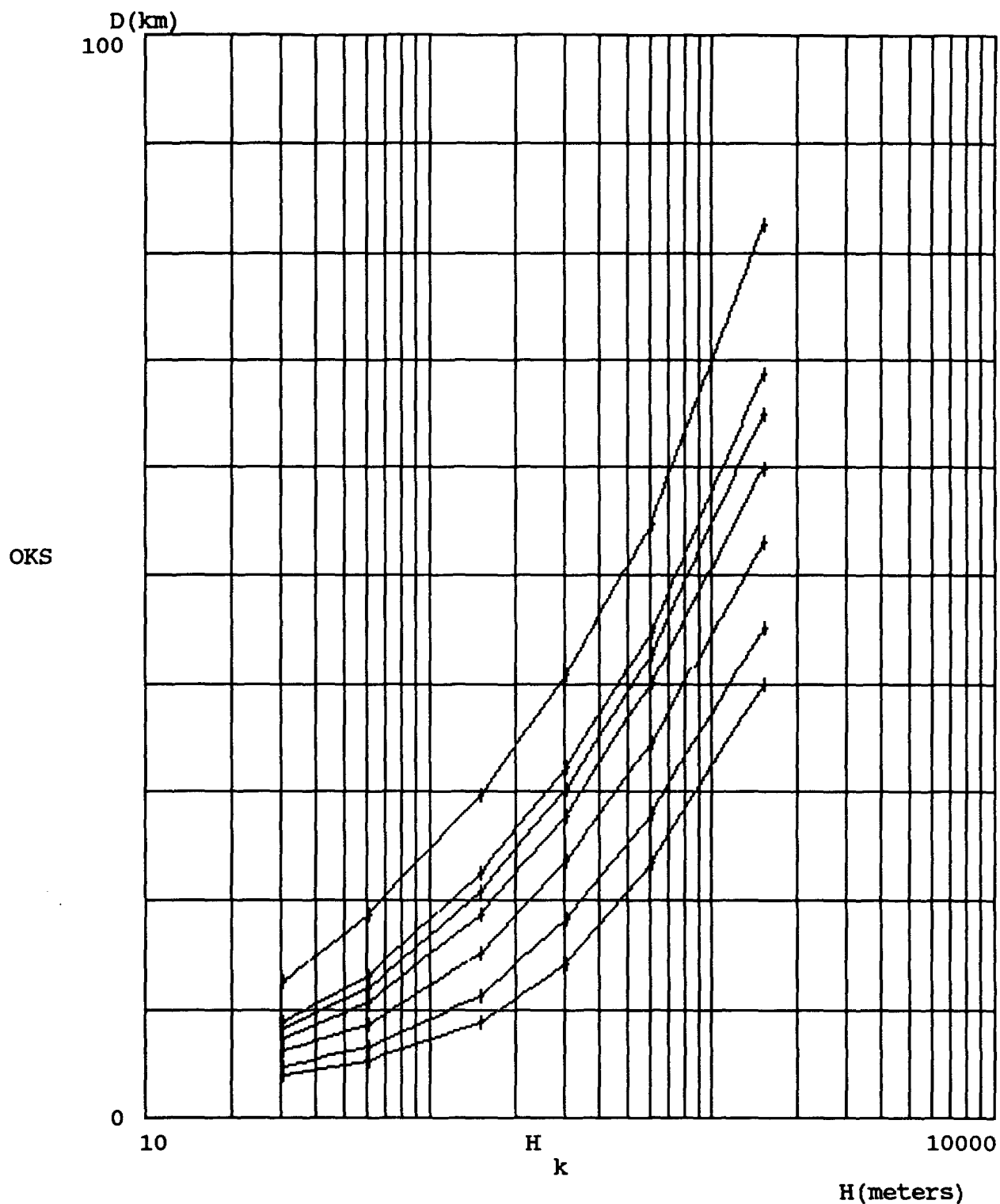
Figure B5 contains listings of the 'Okumura' Reference data, errors, and relevant results.

Figure B2. 931 MHz PAGING SERVICE CONTOUR DISTANCE



931 MHz Paging Service Contour Distances as calculated from proposed formula as a function of Height for ERP's of 50, 100, 250, 500, 750, 1000, 3500 watts.

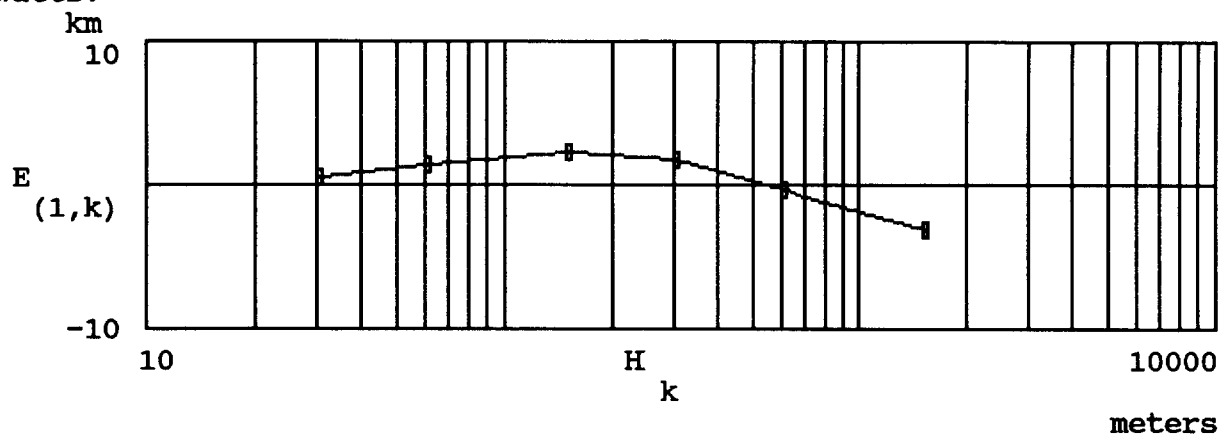
Figure B3. 931 MHz PAGING 'Okumura' Reference Service Contour Distances



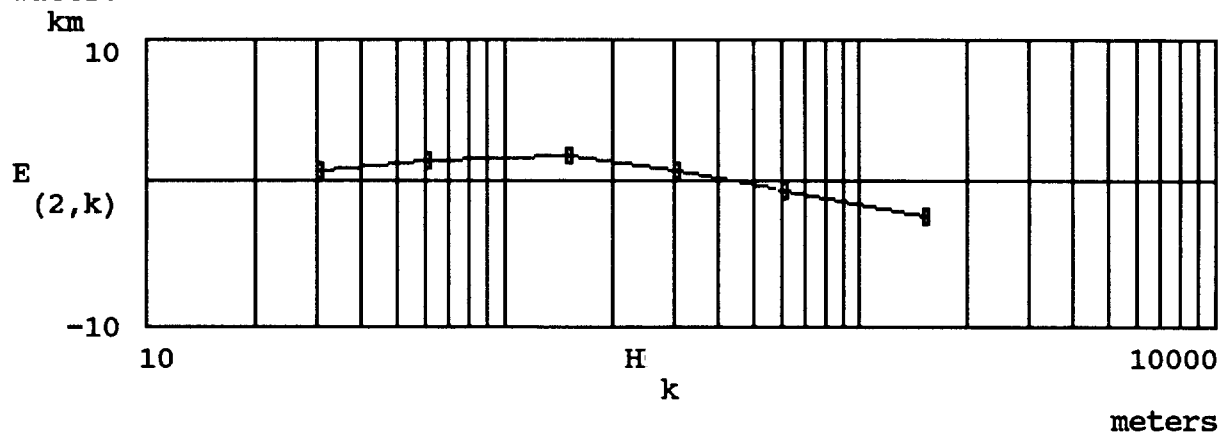
931 MHz Paging 'Okumura' Reference Service Contour Distances  
as a function of Height for ERP's of  
50, 100, 250, 500, 750, 1000, 3500 watts.

Figure B4. PLOTS of 'Formula Distance' - 'Okumura Reference Distance' as a function of height for various ERP's

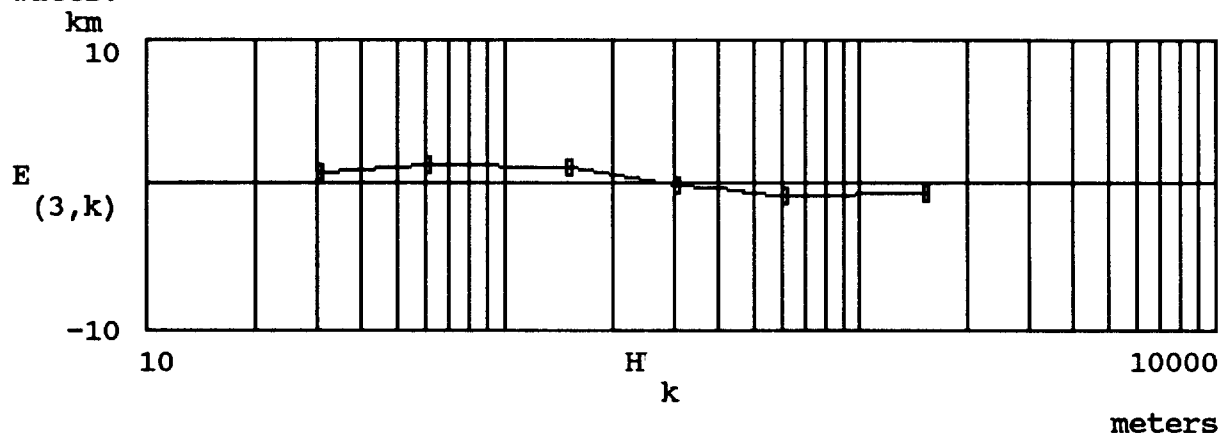
50 watts:



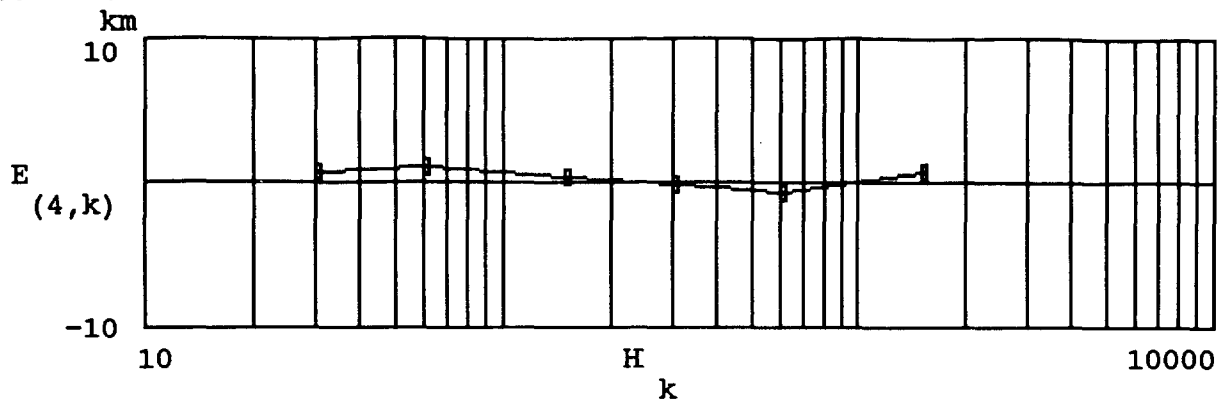
100 watts:



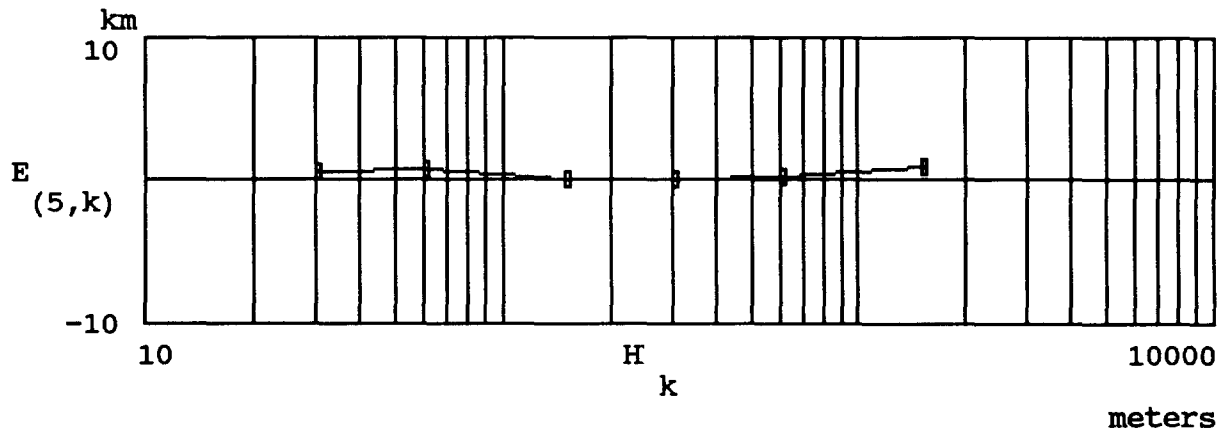
250 watts:



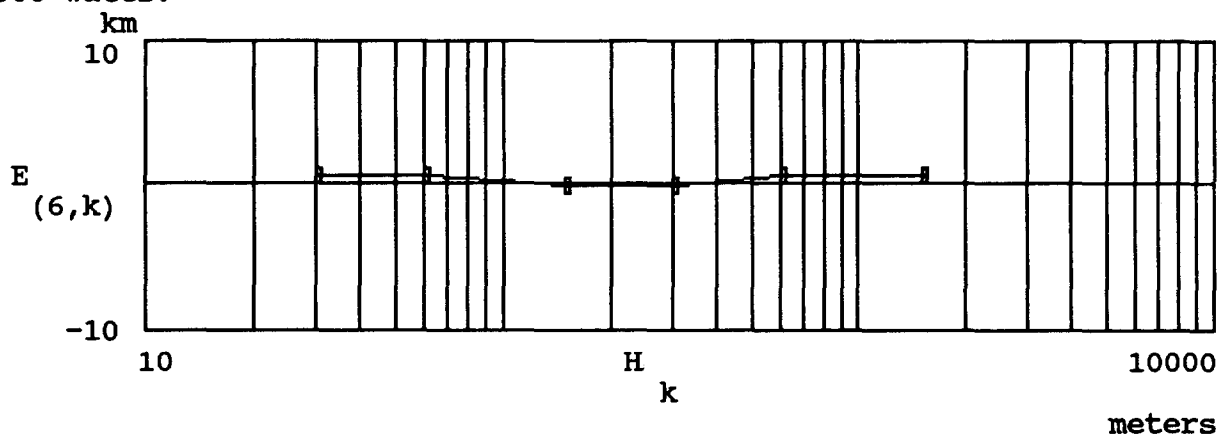
500 watts:



750 watts:



1000 watts:



3500 watts:

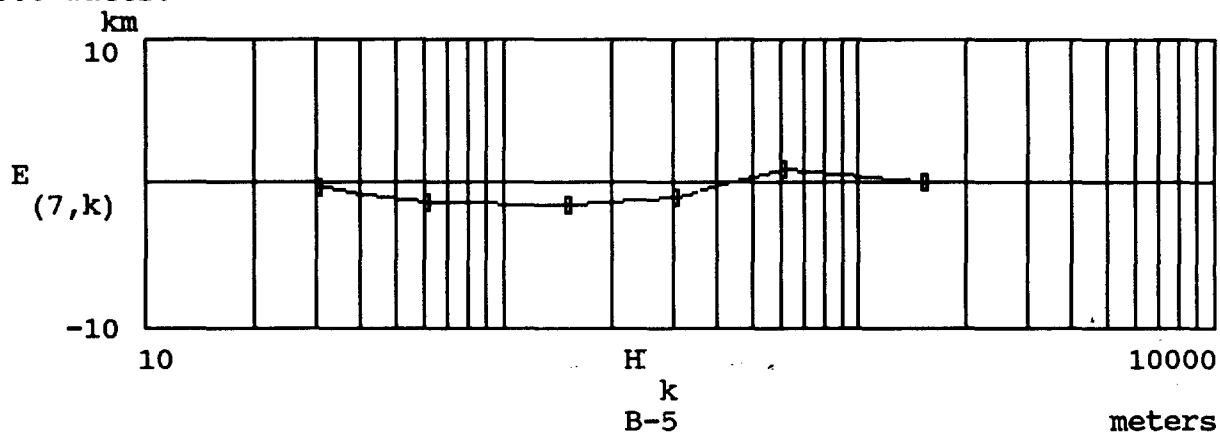


Figure B5. Basic 931 MHz Paging Service Contour Data

Elevations Used: 100, 200, 500, 1000, 2000, 5000 ft.  
30.5, 61.0, 152.4, 304.8, 609.6, 1524 meters

ERP's Used: 50, 100, 250, 500, 750, 1000, 3500 watts

Matrix of 'Okumura' Reference Service Contour Distances (km):

		Elevation→							
OKS =	[	4.023	5.311	8.851	14.323	23.496	39.912	ERP	↓
		4.667	6.598	11.265	18.347	28.003	45.223		
		6.116	8.69	15.289	23.657	34.601	53.108		
		7.403	10.622	18.829	27.842	40.073	59.868		
		8.208	12.07	20.922	30.256	42.809	64.857		
		8.851	13.197	22.531	32.187	44.901	68.719		
		12.553	18.829	29.612	40.877	54.718	82.56		

Error Matrix for points in above matrix:

'Formula calculated distance' - 'Okumura Reference Distance' (km)

E =	[	0.648	1.494	2.311	1.846	-0.237	-3.168
		0.858	1.446	1.918	0.722	-0.645	-2.336
		0.771	1.326	1.096	-0.01	-0.807	-0.692
		0.708	1.162	0.406	-0.144	-0.629	0.777
		0.7	0.856	0.14	0.018	0.197	0.888
		0.655	0.582	-0.119	-0.021	0.698	0.681
		-0.296	-1.255	-1.452	-0.968	1.025	0.011

A row by row plot of these errors is presented in Fig. B4.

Standard Deviation of Above Errors:  $\sigma = 7.189$  km

Contour distance (km) at 1000 watts, 305 meters:

$$0.280 \cdot 305 + \frac{0.545 - 0.00000598 \cdot 1000}{1000} + \frac{0.244 - 0.0000117 \cdot 305}{1000} = 32.177$$



Figure B6. Proposed 931 MHz Interference Formula.

The following formula has been developed for calculating 931 MHz Interference Contour Distances:

$$d = 3.64 \times h^{(0.379 + 0.0000006 \times p)} \times p^{(0.132 + 0.0000083 \times h)}$$

where

d is the radial distance in kilometers

h is the radial antenna HAAT in meters

p is the radial ERP in watts

This formula was developed as a fit to the 'Okumura' Reference Interference data originally used to develop the distances in the current FCC tables for 931 MHz paging. The original data is contained in Telocator's Comments filed in CC Docket No. 88-135, RM-5555.

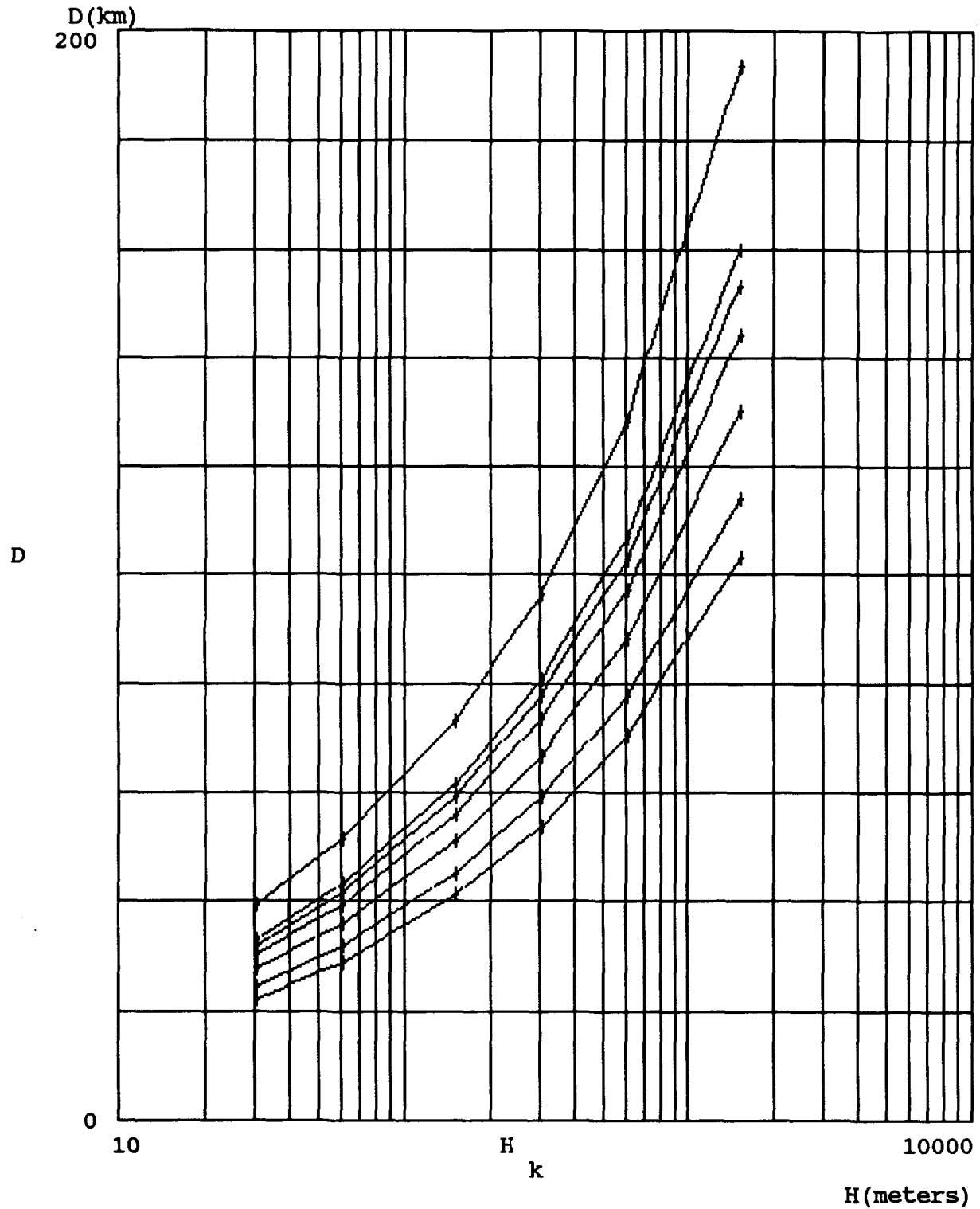
Figure B7 contains a series of plots of the proposed formula.

Figure B8 contains a series of plots of the 'Okumura' Reference interference data for the same points displayed in Figure B7.

Figure B9 contains a series of plots of the differences between the proposed formula results and the 'Okumura' Reference data.

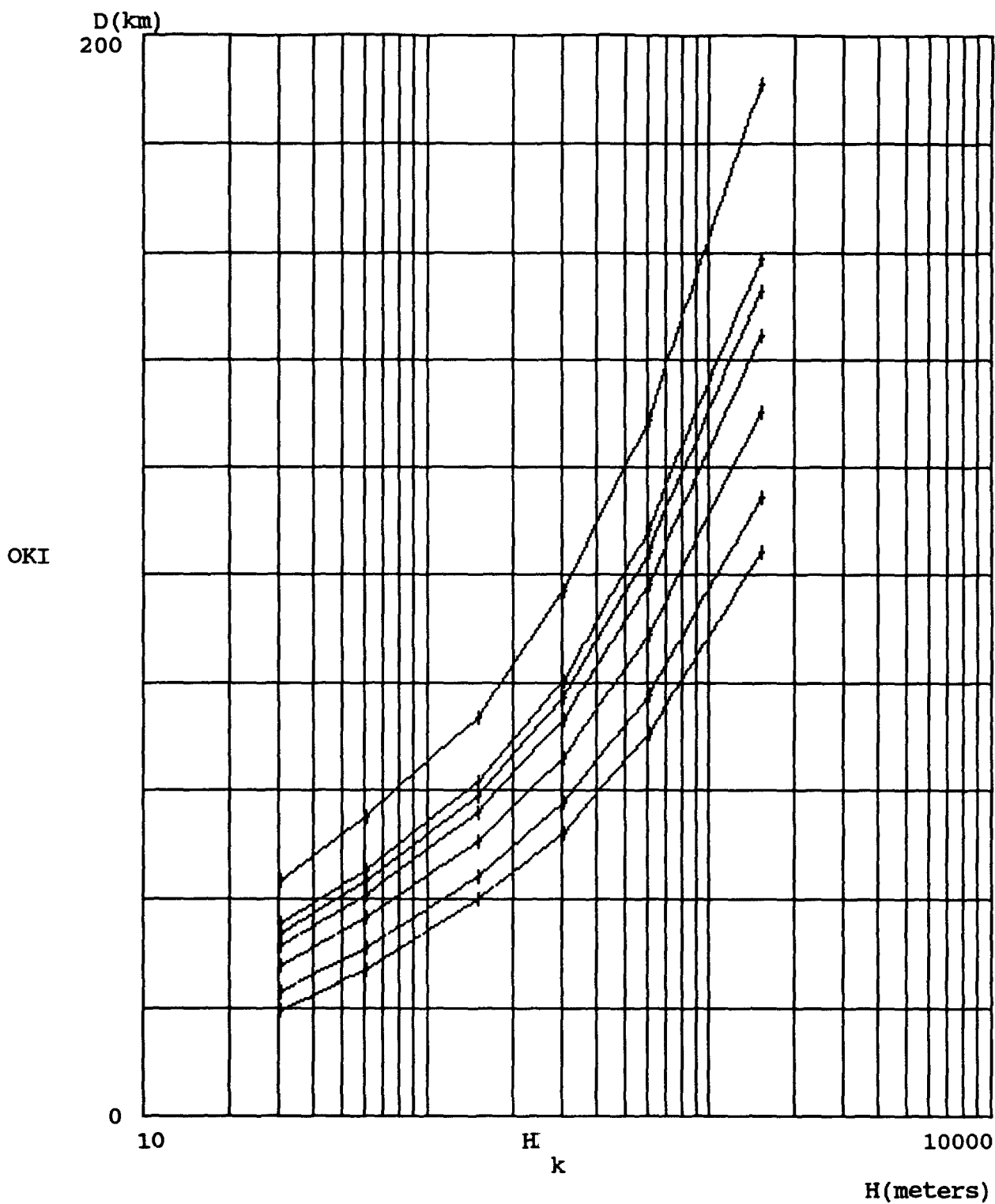
Figure B10 contains listings of the 'Okumura' Reference data, errors, and relevant results.

Figure B7. 931 MHz PAGING INTERFERENCE CONTOUR DISTANCE



931 MHz Paging Interference Contour Distances as calculated from proposed formula as a function of Height for ERP's of 50, 100, 250, 500, 750, 1000, 3500 watts.

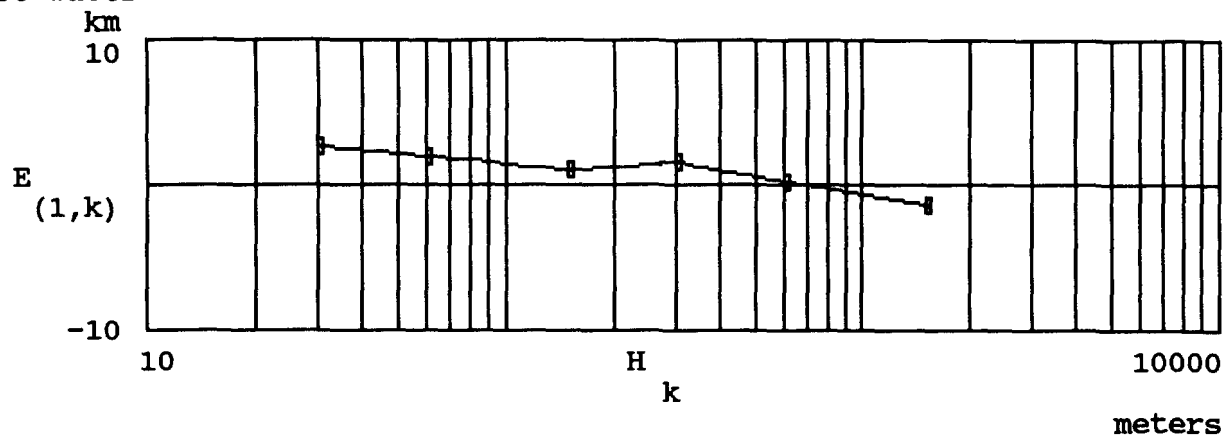
Figure B-8. 931 MHz PAGING 'Okumura' Reference Interference Contour Distances



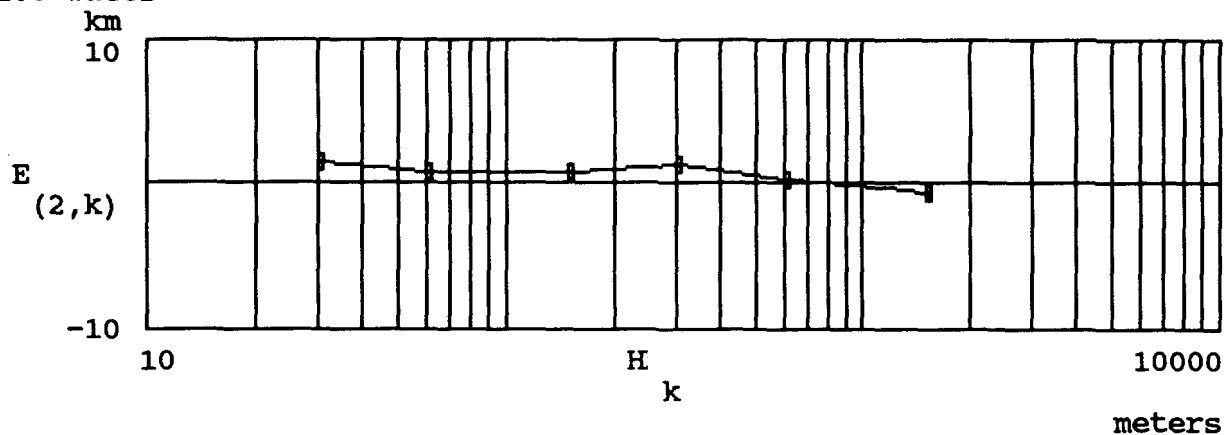
931 MHz Paging 'Okumura' Reference Interference Contour Distances as a function of Height for ERP's of 50, 100, 250, 500, 750, 1000, 3500 watts.

Figure B9. PLOTS of 'Formula Distance' - 'Okumura Reference Distance' as a function of height for various ERP's.

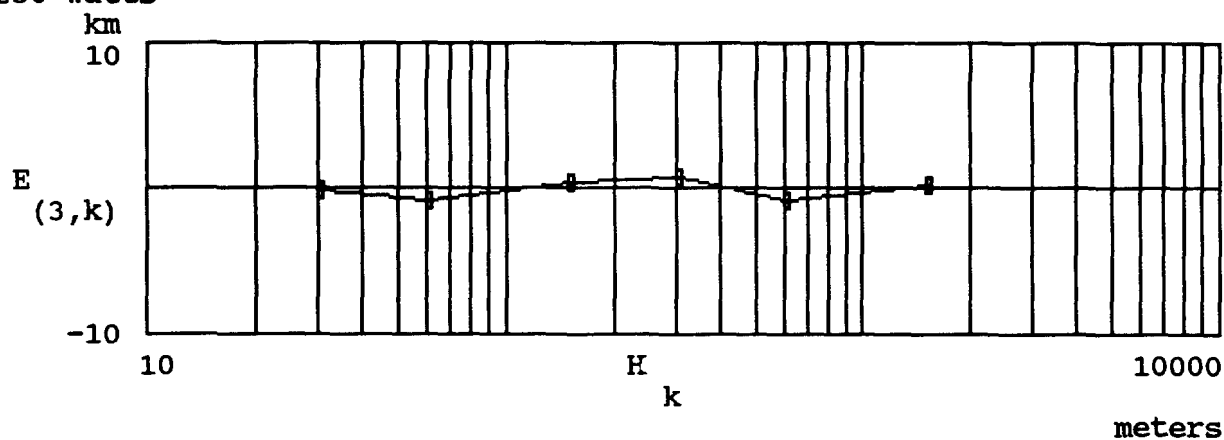
50 watts



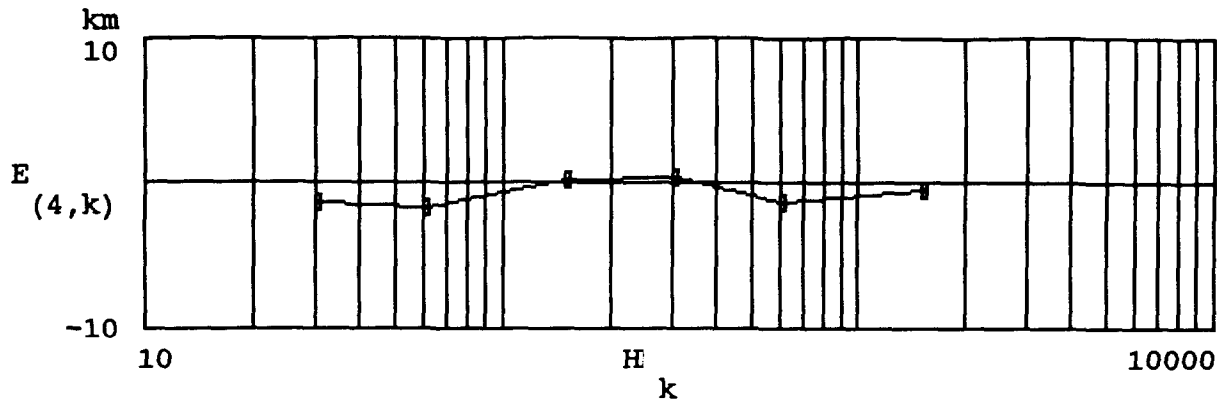
100 watts



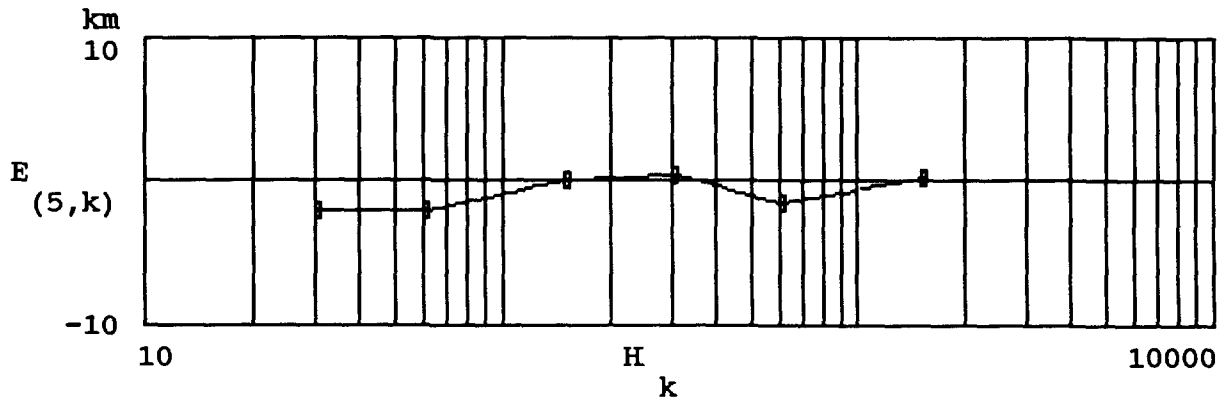
250 watts



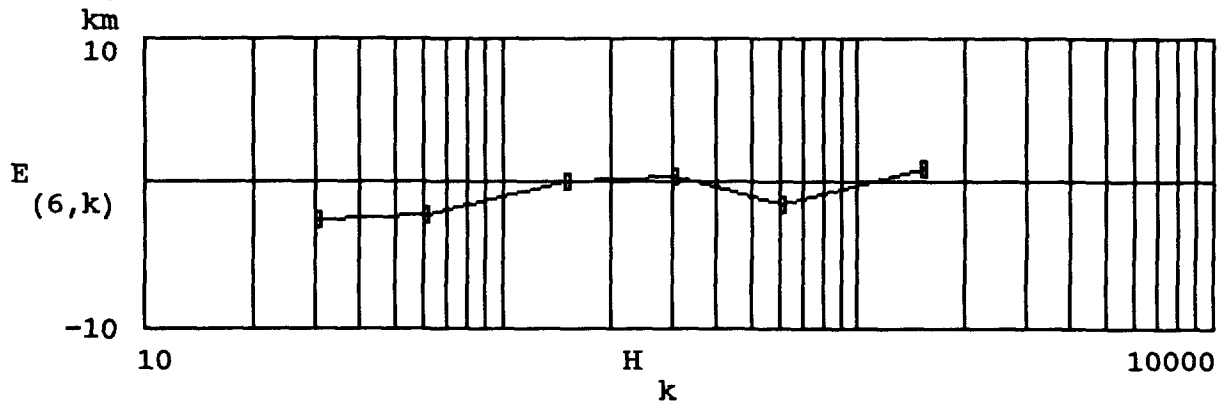
500 watts



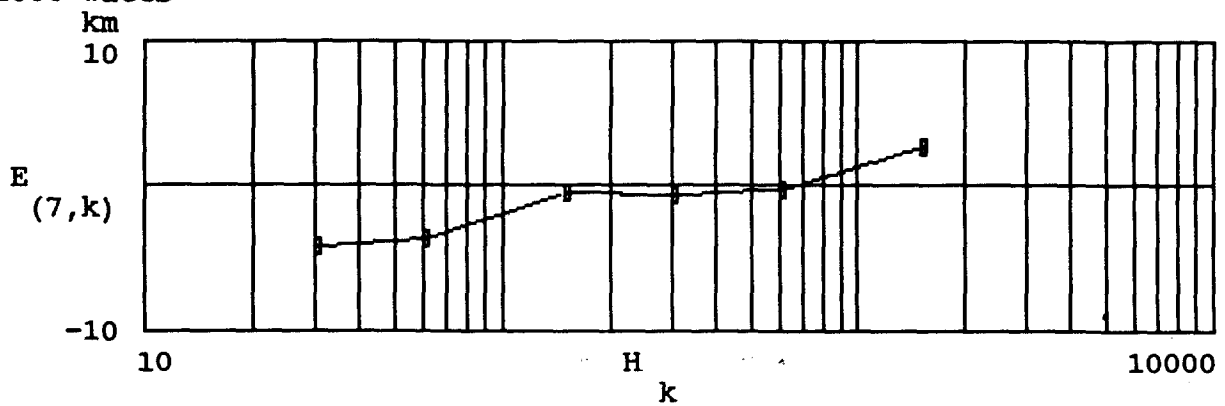
750 watts



750 watts



1000 watts



B-11

Figure B10. Basic 931 MHz Paging Interference Contour Data

Elevations Used: 100, 200, 500 1000, 2000, 5000 ft.  
30.5, 61.0, 152.4, 304.8, 609.6 1524 meters

ERP's Used: 50, 100, 250, 500, 750, 1000, 3500 watts

Matrix of 'Okumura' Reference Interference Contour Distances (km):

		Elevation→							
OKI =	19.473	27.037	40.073	52.143	70.489	104.447	E R P ↓		
	22.853	31.06	44.418	57.776	77.571	114.586			
	27.681	36.693	50.694	66.144	88.997	130.035			
	31.543	41.038	55.844	73.064	98.492	144.519			
	33.957	43.613	59.063	77.249	104.286	152.727			
	35.728	45.545	61.477	80.467	108.47	158.682			
	43.613	55.04	73.708	97.044	128.587	190.869			

Error Matrix for points in above matrix:

'Formula calculated distance' - 'Okumura Reference Distance' (km)

E =	2.826	1.991	1.131	1.706	0.236	-1.336
	1.589	0.763	0.779	1.347	0.219	-0.576
	-0.081	-0.748	0.396	0.769	-0.747	0.219
	-1.279	-1.611	0.233	0.451	-1.354	-0.37
	-2.009	-1.984	0.172	0.455	-1.498	0.297
	-2.523	-2.271	0.12	0.372	-1.445	1.02
	-4.224	-3.636	-0.369	-0.54	-0.285	2.677

A row by row plot of these errors is presented in Fig. B8.

Standard Deviation of Above Errors:  $\sigma = 9.816$  km

Contour distance (km) at 1000 watts, 305 meters:

$$3.64 \cdot 305 \cdot \frac{.379 + .0000006 \cdot 1000}{1000} + .132 + .0000083 \cdot 305 = 80.86$$

Figure C1. Proposed VHF One-Way or Two-Way Mobile Service Contour Formula.

The following formula has been developed for calculating VHF One-Way or Two-Way Mobile Service Contour Distances:

$$d = 1.97 \times h^{(0.368-0.0000106 \times p)} \times p^{(0.201-0.0000221 \times h)}$$

where

d is the radial distance in kilometers  
h is the radial antenna height in meters  
p is the radial ERP in watts.

Figure C2 contains a series of plots of the proposed formula.

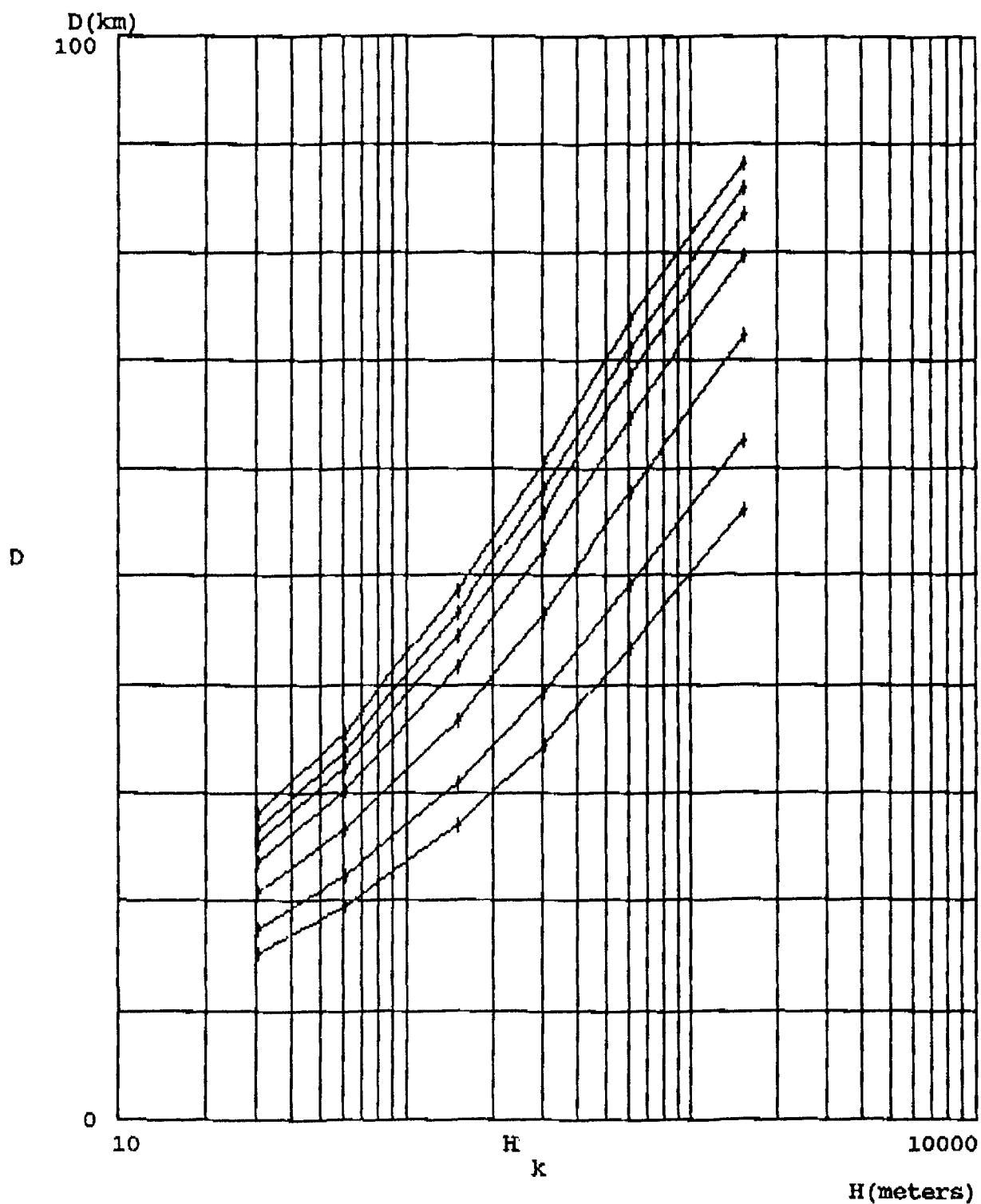
Figure C3 contains a series of plots of the Carey 37 dBu Service Contour Distances for the same points displayed in Figure C2.

Figure C4 contains a series of plots of the differences between the proposed formula results and the Carey Service Contour data.

Figure C5 contains listings of the Carey 37 dBu Service Contour data, errors, and relevant results. Errors for the FCC Proposed equation are also listed. The equation used for these calculations was:

$$d = 1.527 \times h^{0.40} \times p^{0.21}$$

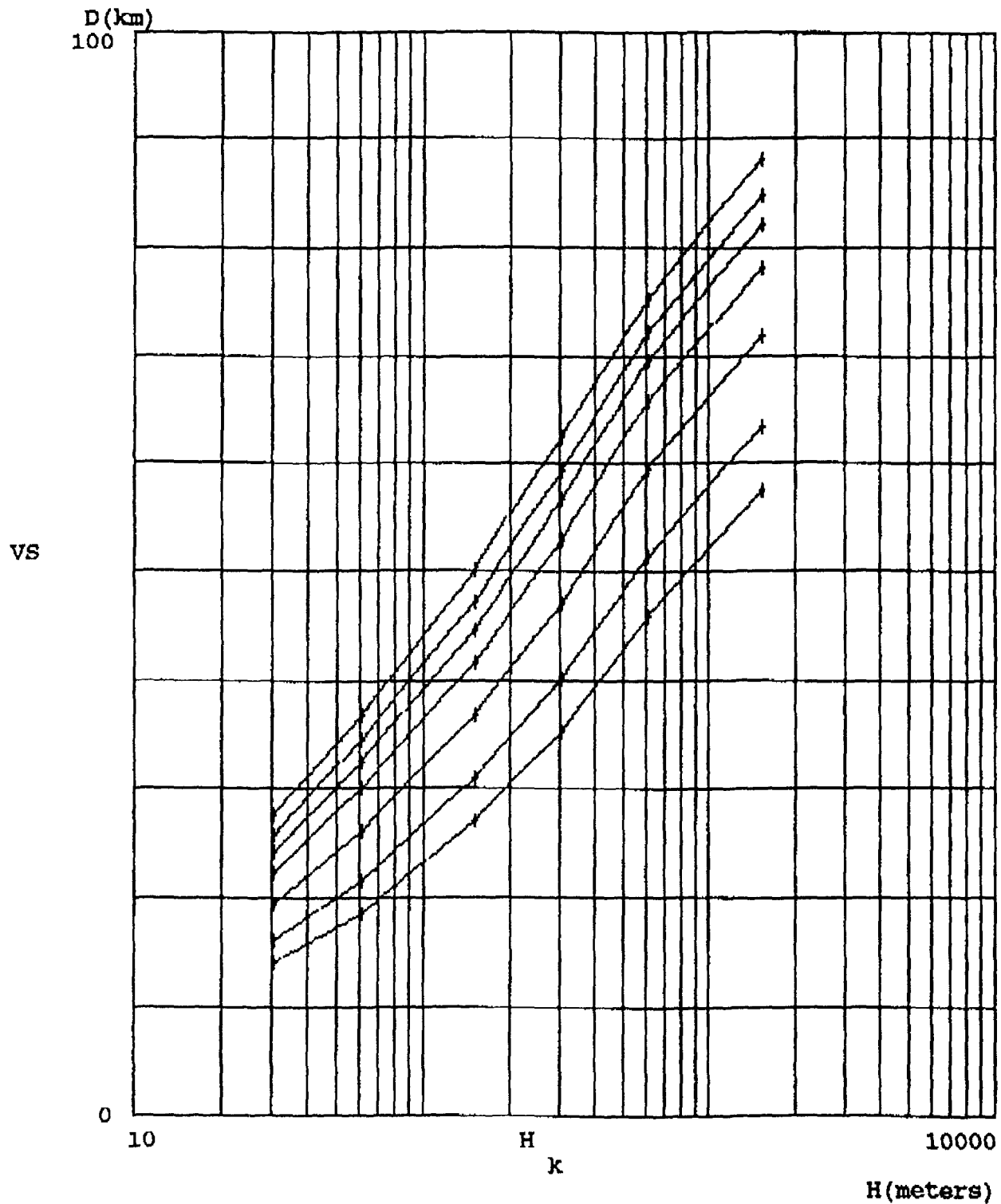
Figure C2. VHF ONE-WAY OR TWO-WAY MOBILE SERVICE CONTOUR DISTANCE



VHF One-Way or Two-Way Mobile Service Contour Distances as calculated from proposed formula as a function of Height for ERP's of 50, 100, 250, 500, 750, 1000, 1400 watts.



Figure C3. VHF 37 dBu Service Contour Distances



VHF One-Way or Two-Way 37 dBu Service Contour Distances  
as a function of Height for ERP's of  
50, 100, 250, 500, 750, 1000, 1400 watts